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TECHNOLOGY

TRANSFER

AND

COMMERCIALIZATION



TECHNOLOGY

TRANSFER

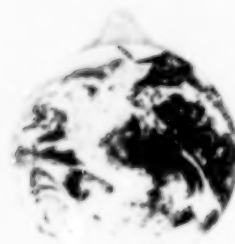
REPORT

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JUL 23 1995

**NASA
TECHNOLOGY
FOCUSING
ON EARTH
APPLICATIONS**



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ASA Goddard Space Flight Center's (GSFC) Technology Transfer/Commercialization Office is dedicated to the strengthening of American businesses through the transfer of GSFC technology. The GSFC technology transfer and commercialization programs seek to extend NASA technologies beyond the boundaries of the nation's space program, ensuring that the lives of all Americans benefit from the discoveries founded in GSFC research and development (R&D).

Technology transfer and commercialization have been a part of the GSFC R&D agenda for decades. GSFC introduced technology to the commercial marketplace as early as the 1960s in the form of an automatic implantable cardioverter defibrillator, used as a cardiac pacemaker device. Since then, hundreds of GSFC technologies have found their way into commercial products and, ultimately, into the lives of everyday citizens.

Today's global economic environment and scarcity of resources has heightened the importance of technology transfer and commercialization. Therefore, working with the commercial marketplace to transfer existing technologies and to develop new ones is a vital component of the nation's agenda in general and of GSFC's agenda in particular. Through its inreach and outreach programs, the GSFC Technology Transfer/ Commercialization Office enables the transfer and commercialization of its R&D technology.

In all aspects, 1995 has been both a challenging and a rewarding year for the GSFC Technology Transfer/Commercialization Office. Several new technologies have been transferred or commercialized. We continue to identify exciting technologies in areas such as information systems, sensors and detectors, optics, and environmental systems that will have marketplace utility. As we continue to implement programs and practices outlined in the 1994 NASA Commercial Technology Agenda for Change and experience increased participation and partnering from the commercial sector, GSFC technology is committed to reaching its full scientific and economic potential for our nation.

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merica is about a vision. America is about investments in the future.

The space program is owned by the American people, and the

American people have an expectation and a vision of the year 2015.

NASA is committed to the future of this country. We are about a long

term vision for this Country. We are about a robust and vital society; a healthy

environment; intellectual nourishment; understanding how solar systems form;

how galaxies form; as well as how the universe formed.

We have been doing a series of things to try to bring together different
states and industries with NASA to do more proactive technology transfer.

NASA is looking at new forms of looking down at Earth.

It is essential that we don't cancel the last element of longterm
investment in America's future with our continuing R&D. Longterm R&D is
crucial. As a society, we'll dry up, we'll wither, and we'll no longer exist the
very minute we stop investing in our future.”

— *Daniel S. Goldin*

*ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NEW ENGLAND NASA BUSINESS AND TECHNOLOGY CONFERENCE LUNCHEON
PROVIDENCE, RHODE ISLAND – AUGUST 1995
(paraphrased)*



NASA GODDARD SPACE FLIGHT CENTER TECHNOLOGY TRANSFER/ COMMERCIALIZATION OFFICE

What does the NASA/GSFC Technology Transfer/ Commercialization Office do?

The NASA/Goddard Space Flight Center (GSFC) Technology Transfer/Commercialization Office is a liaison between GSFC and U.S. industry, other government agencies, and academia to transfer and commercialize GSFC technologies.

Following the precepts of the July 1994 NASA Commercial Technology Agenda for Change, the mission of the GSFC Technology Transfer/Commercialization Office is two-fold: To develop and implement effective marketing strategies; and to facilitate partnering relationships with U.S. industry, other government agencies, and academia for the transfer/commercialization of GSFC-developed technologies.

Marketing

Under the realm of marketing, the Technology Transfer/Commercialization Office uses an internal and external network to

disseminate information on GSFC technology to the widest audience possible. Framed around both inreach and outreach programs, this effort employs electronic and print media to communicate the development and availability of new technologies with potential commercial applications. The media include database systems, the Internet, videos, advertisements, brochures, and several professional and trade publications.

Inreach Program

The Inreach Program is key to heightening the awareness and participation of GSFC personnel in technology transfer and commercialization. It is also responsible for center-wide technology transfer training courses; ongoing consultation with GSFC scientific and technical personnel; annual recognition programs; GSFC sponsored colloquia; and employee development programs.

Outreach Program

GSFC's Outreach Program is structured to identify and increase awareness of GSFC technological resources to businesses, universities, and other public and private entities within the U.S. This is accomplished through professional and trade conferences and meetings; on-site and regional commercialization workshops; technology demonstrations; facility tours; and consultations with U.S. industry. The Technology Transfer/Commercialization Office also

works diligently to communicate GSFC's resources within the state and local government arena. This is accomplished through its involvement with economic development offices; chambers of commerce; high tech councils; educational institutions; and science and technical organizations.

Electronic Communications Network

The GSFC Technology Transfer/Commercialization Office has initiated an electronic communications network to efficiently communicate internally and externally GSFC technology transfer opportunities. This is done through the use of the NASA Commercial Technology Network and GSFC's home page on the Internet.

GSFC home page:

http://www.gsfc.nasa.gov/GSFC_homepage.html

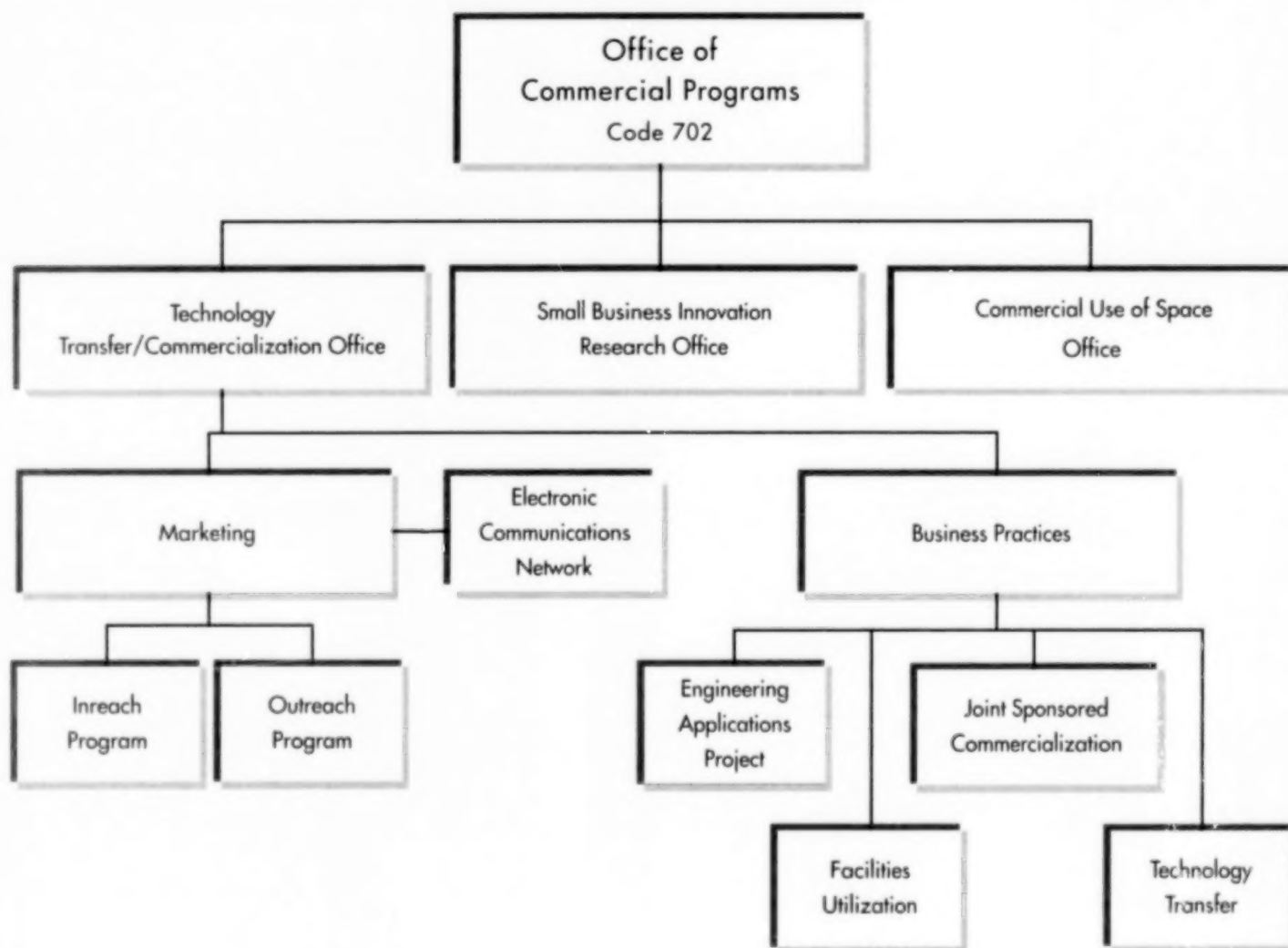
GSFC Public Affairs Office home page:

<http://pao.gsfc.nasa.gov/gsf.html>

NASA Commercial Technology Management Team home page:

<http://nctn.hq.nasa.gov/NCTNHome.html>

Office of Commercial Programs Organization and Program Structure



What does GSFC market?

- Expertise
- Facilities
- Technologies

GSFC partnering activities:

As outlined in its mission, the Technology Transfer/Commercialization Office of GSFC initiates partnerships with U.S. industry, other government agencies, or academia to apply NASA-developed technologies to industrial and national needs.

One aspect of the partnering is facilities utilization, where specific GSFC facilities are available for use, on a non-interference basis, by any of these entities for research and development analysis, as well as performance testing of their products. As a means of partnering, GSFC's Technology Transfer/Commercialization Office also

coordinates and participates in both the Engineering Applications Projects and the Joint Sponsored Commercialization. The Engineering Applications Project is a cost-shared R&D program. The Joint Sponsored Commercialization encompasses a dual-use technology R&D approach.

How does GSFC partner?

- Memorandums of Understanding (MOUs)
- Space Act Agreements (funded/unfunded)
- Contracts (cost-shared)
- Licenses

Where is the GSFC Technology Transfer/Commercialization Office?

The GSFC Technology Transfer/Commercialization Office is located at NASA Goddard Space Flight Center, Office of Commercial Programs (OCP), Building 11, Room C1, Mail Stop 702, Greenbelt, MD 20771.

Telephone: (301) 286-5810

Fax: (301) 286-0301

GSFC Office of Commercial Programs homepage:

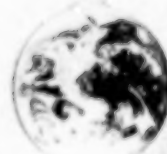
[Http: //afc.gsfc.nasa.gov/ocp/OCPHome.html](http://afc.gsfc.nasa.gov/ocp/OCPHome.html)

George Alcorn: Chief, Office of Commercial Programs

Nona Minnifield: Manager, Commercial Research

COMMERCIAL PARTNERS

**Since the 1960s, hundreds of
GSFC technologies have become
commercial products and affect
the lives of Americans.**



Commercial Partners

High Data Rate Telemetry Acquisition and Processing System

Consultive Committee for Space Data System (CCSDS) Gateway System

Description: The CCSDS Gateway System (CGS) acquires and processes satellite telemetry data and performs the networking functions required to seamlessly interconnect local/wide area networks to space communications networks. The CCSDS communications protocol has become the standard of the majority of the world's space agencies, including European Space Agency (ESA), the Department of Defense (DOD), National Space Development Agency (NASDA), and NASA.

The CGS product family autonomously performs telemetry data processing and distribution for satellite imaging and synthetic aperture radar applications at data rates up to 300+ Mbps. The CGS minimizes the costs and complexity of accessing satellite data by processing and distributing data in realtime via standard networks and communications protocols.

Partnered Technology at-a-glance:

Partner: TSI/TELESYS
Market: Satellite Communications, Space Data Handling, Earth Observing Systems, Military Data Handling, Ground Data Transmission Handling
Contact: Jim Chesney, CEO
(410) 872-3900

Weather in the Cockpit

Description: Weather in the Cockpit is a three-dimensional interactive weather and information system. This system provides high-resolution satellite-based weather image products. The processing will be faster and of greater accuracy, with real time weather information. The new weather products will be available either through an onboard computer or at a flight service station terminal. In addition, the system will be able to provide preflight information and the ability to prefly a desired flight plan.

The weather information will be gathered from the weather services of National Oceanographic and Atmospheric Administration (NOAA), National Weather Service (NWS), and NASA. The system software merges or fuses these visible and infrared satellite images into a single product. Further, it correlates this data via Global Positioning System (GPS) reference to the national airspace grid. As part of the system, a historical

weather database will be maintained for current and future weather patterns and predictions. When a flight crew requests weather data, the system (a) uplinks current three-dimensional weather data, and (b) weather forecasts for any desired area or flight plan.

To enhance the weather data collected from NOAA and NSW, sensors on board the aircraft will be polled. The polled weather data can then be transmitted to the real time weather system. This will provide actual weather measurements and observations directly from the aircraft. Specific positions and altitudes could then be integrated into the current weather database.

The Real Time Weather System will offer pilots the ability to prefly their flights, allowing them to choose the safest, most fuel- and time-efficient flight plan. They will have weather, wind shear and terrain data available to make the safest flight plan decisions possible. This would eliminate en route surprises and could ultimately save lives. Further, better flight information, preparation, and planning can save time as well as fuel.

The weather system is applicable to fire fighting. The system will be used to merge weather data and hazardous plume information (graphical observation and sensors data) to guide evacuation management. Further, the industry would like to apply the three-dimensional

"flight plan" visualization approach to mobile and hand-held computers to assist fire fighters in navigating through smoke-filled skyscrapers. In this virtual building concept, a fire fighter would wear a computer on his or her waist, and an eye piece in his helmet to locate fire-fighting resources, elevators, stairwells, and exits.

Partnered Technology at-a-glance:

Partner: Global Science and Technology (GS&T), Advanced Satellite Telecommunications, Incorporated, Cornwall

Market: Aeronautics, Fire-fighting

Contact: Bill Campbell
NASA/GSFC, Code 935
(301) 286-8785

Earth Alert

Description: The Earth Alert Program (EAP) continues to refine its systems for providing personal warning to isolated populations in the path of natural or man-made disasters. The system employs weather satellite analog communication channels to relay warnings to threatened populations in distant island environments, where terrestrial communications are ineffective. Several techniques have been developed. These include direct down-linking from the satellite to the user and the "bent pipe" approach. In the latter, the downlinked signal is rebroadcast to inexpensive VHF personal receivers.

In 1995, EAP reduced its VHF receiver to approximately the size of an ordinary pager but retained the simple, non-language-dependent display. The display can show ten different messages, which are customized for the natural threats of the operational area. A more advanced model was also introduced. It can present a map of the



Janice Leek of SCSC demonstrates the scale of the Earth Alert Tower

threat area and indicate the location and direction of movement of the emergency to a resolution of one sixty-fourth of the map size. The Earth Alert utility has further expanded via development of a method for multiband RF dissemination and distribution of the warnings throughout large buildings, such as hotels and hospitals, without the need for extensive rewiring.

The Earth Alert team has begun collaboration with the National

Weather Service and National Weather Radio (NWR) to extend NWR warning access to the public through Earth Alert technology.

Partnered Technology at-a-glance:

Partner: Scientific and Commercial Systems Corporation (SCSC)

Markets: Geographic areas prone to natural disasters

Contact: Thomas F. McGraw
SCSC Engineering Division Director
(301) 210-0250

Advanced Transmission Line Inspection System (ATLIS)

Description: In 1995, ManTech, Incorporated obtained a non-exclusive license on technology to develop an Advanced Transmission Line Inspection System (ATLIS). This robotic crawler device has a flexible design that enables it to navigate over virtually any surface or environment. Its compliant cable structure allows flexibility in this device and also controls the robot's actuators, which allow ATLIS to bend and adjust itself to irregular surfaces. ManTech's ATLIS robot maneuvers over high-voltage transmission lines as it inspects them. The ATLIS robot eliminates the need for human inspectors to perform overhead climbing and removes them from exposure to powerful electro-magnetic fields.

This year, a working lab prototype was completed and discussions were held with the Electric Power Research Institute's (EPRI) Overhead Transmission Assessment and Inspection Methods Task Force. A business plan has been presented to numerous domestic firms to attract investors for continued development of the ATLIS system. Funding commitments were sought in 1995 to develop the ATLIS system to its fieldable stage.

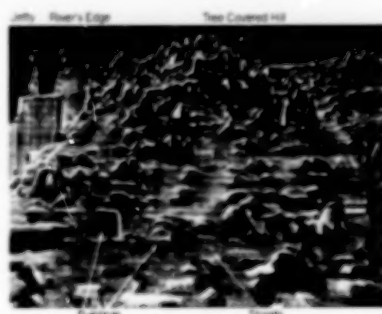
Partnered Technology at-a-glance:

Partner: ManTech, Incorporated
Markets: Transmission Line Inspection, Tower Painting, and Sandblasting
Contact: Ed May
Manager of Robotics Technology
Engineering Center
(410) 312-3896

LIDAR Topographic Mapping System

NASA developed a timely, cost-effective, and accurate topographic mapping system using airborne Light Detection and Ranging (LIDAR) technology. The system has had two maiden flights for the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers (ACOE). These

data were successfully processed in 1995. Airborne LIDAR Topographic Mapping System (ALTMS) data from the FEMA mission were analyzed by the U.S. Geological Survey. Initial results indicate an average elevation accu-



racity over bare ground of approximately 1.5 feet when compared to conventional photogrammetric mapping methods. The intent of this mission was to evaluate the accuracy of numerous airborne mapping technologies over a heavily impacted and eroded flood plain of the Missouri River.

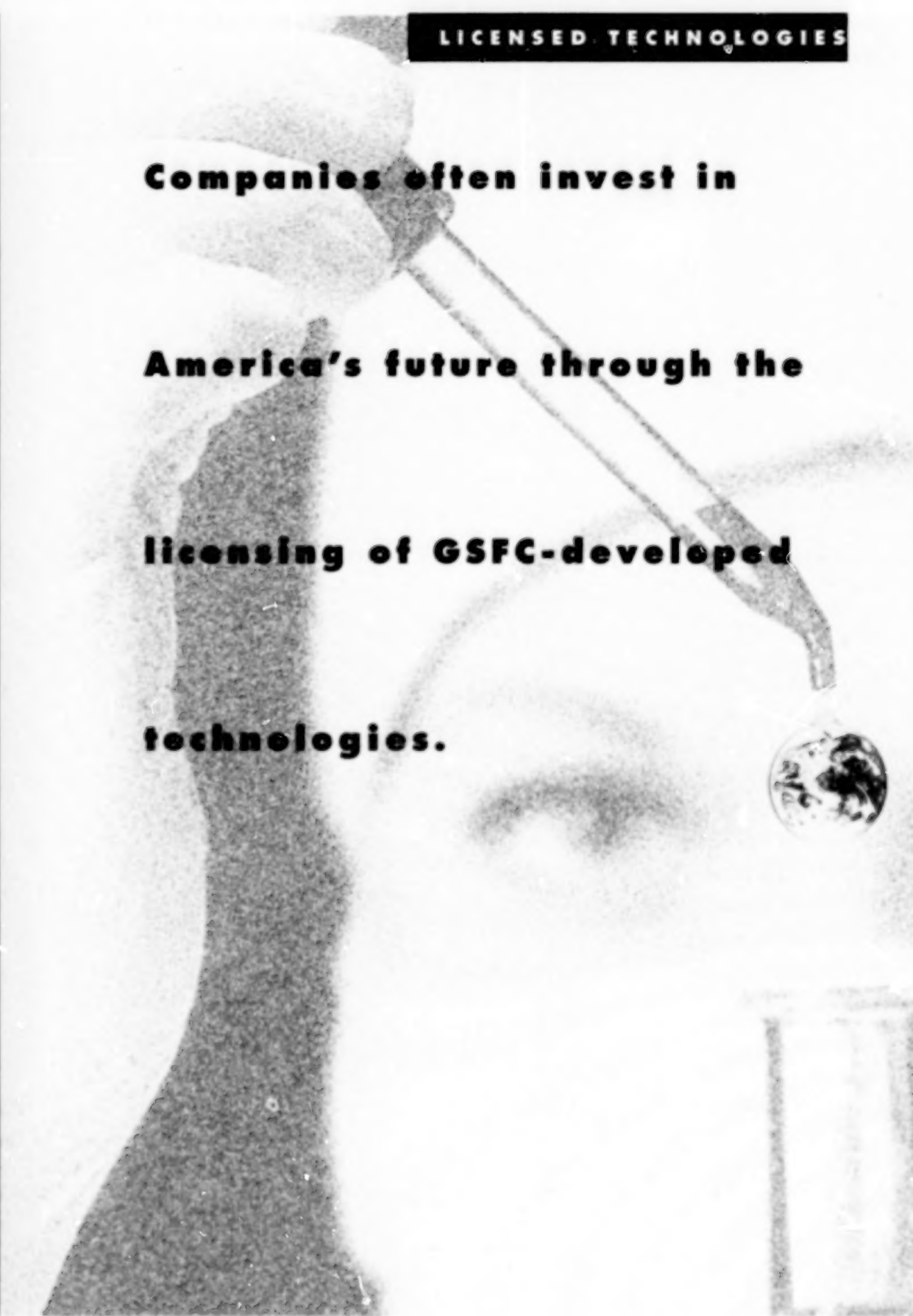
The second mission was flown along a Nebraska portion of the Missouri River in order to assess the use of ALTMS data to map endangered bird species habitats (on islands). The processed data have been sent to the ACOE and are presently being evaluated. Initial system products were developed. They included Digital Elevation Models (DEM) and video

integration (overlay) with the DEMs.

Negotiations have begun to license the ALTMS technology with a commercial partner. An initial survey of potential mapping projects was conducted through interviews with major national and international oil and gas, forestry, remote sensing, and engineering/construction companies. Responses indicated that contracts for ALTMS data and associated applications could be made almost immediately. A detailed schedule has been developed to transfer the technology to the commercial partner within two or three months of signing an agreement (early 1996). A comprehensive business plan has been initiated in order to take the technology to the marketplace immediately.

Partnered Technology at-a-glance:

Partner: Houston Advanced Research Center
Markets: Aerial Mapping, Forest Inventory, Pipeline and Construction Surveys, Flood Plain Mapping, and Insurance Assessments
Contact: Jack Hill
Director of Environmental Information Systems Laboratory
(713) 363-7999



LICENSED TECHNOLOGIES

**Companies often invest in
America's future through the
licensing of GSFC-developed
technologies.**

Licensed Technologies

Walking Assistance Device (Walker)

Description: Cable compliance uses many segments of stranded wire rope (cable) in a highly adjustable configuration for coupling, mating, and force-transmission operations. The cable is typically stainless steel, which makes it extremely durable. The cables are configured so as to make a joint that is tailorable to any desired degree of flexibility.

The cable is compliant when used in bending, but it is not compliant in the typical use of tension. The individual segments are constrained at each end and are short enough to not buckle when compressed. The longer the segment, the more flexibility or compliance is achieved.

The many strands rubbing against one another provide an added benefit: damping. Other devices for vibration or shock protection have significant resonances which limit

their applicability. Joints made of Compliant Cable have only one highly damped resonance.

Applications patented and licensed to date include robotics, physical therapy, and shock isolation.

Wheel Ring, Inc. was granted an exclusive license to develop the Walking Assistance Device (Walker). The Walker was developed to support walking for



The late Dr. James Kerley is shown testing his invention, the Walker

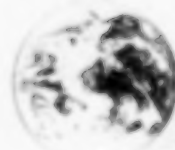
people who have limited use of their lower extremities. The Walker is based on Compliant Cable technology invented at GSFC. The system consists of an upright wheeled frame, that partially surrounds an upright person. The harness is attached to the frame by a cable-compliant connection. The height of the open-ended frame can be adjusted to accommodate the user's increase in upper pressure on his or her body to lessen fatigue in the legs. With the adjustment mechanism, it is possible to first bring the Walker down to the user and then to raise the user to the upright position. The compliant cables also allow adjustments to accommodate the specific needs of each side of the body.

Licensed Technology at-a-glance:

Partner: Wheel Ring, Inc.
Markets: Medical, Rehabilitation, Physical Therapy
Contact: Peter Summers, Wheel Ring, Inc.
(410) 266-8444

GSFC Technology Transfer

**Programs assist universities and
nonprofit organizations in
continuing their research
and development through the
utilization of GSFC-sponsored
technologies.**



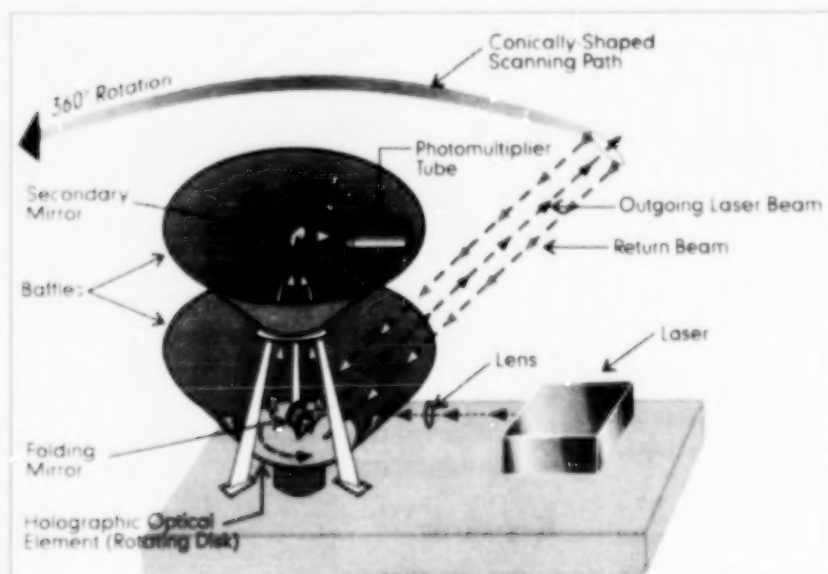
Technology Transferred

Holographic Scanning Telescope

Description: The Holographic Scanning Telescope is a NASA-developed and patented technology with university and industry participation. This technology will provide an alternative to conventional large-aperture scanning receivers for LIDARs to measure atmospheric wind profiles, humidity profiles, temperature profiles, pressure profiles, clouds, aerosol profiles, and for laser altimeters and surface profiling. Many of these measurements are requirements for future NASA and NOAA spaceborne platforms. Since the holographic devices are simpler and lighter.

Since they require fewer parts than the present systems, use of this technology is expected to hasten the development of practical and affordable spaceborne atmospheric LIDAR systems.

A working prototype has been built and tested in a ground-based bread-board holographic LIDAR system at NASA/GSFC. This year GSFC entered into a Memorandum of Agreement with Western Maryland College where Dr. David Guerra will use and operate the system at their Westminster campus to do research on tropospheric pollution and weather, to evaluate the technology, and to train undergraduates in its function and applications. Students who become familiar with this technology via their hands-on training are expected to apply it in other areas, thereby expanding its use.



A Phase 2 SBIR contract with Ralcon, Inc. is underway in which several holographic optical elements (HOEs) are being produced which will extend the wavelength of operation into the near IR and include wavelength multiplexing. In addition, Holographic Optics, Inc. is under a Phase 2 SBIR contract to develop a new method of multiplexing the HOEs used in the Holographic Scanning Telescope that will allow the use of light weighted substrates in the finished products. Successful demonstration of each of these technology improvements will expand the application of diffractive optics.

Technology Transferred at-a-glance:

Partner: Western Maryland College
Markets: Laser Terrain Mappers, Laser Bathymeters Water Depth Mapping, Laser Doppler Wind Sensors, Optical Avoidance Systems for Airplanes, Lightweight Scanning Telescopes, Promotional Attractions (Search Lights), and Laser Probes and Scanners
Contact: Dr. David Guerra
(410) 857-2481

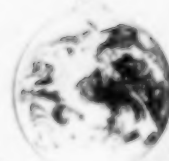
LICENSING OPPORTUNITIES

GSFC is committed to

identifying new and exciting

R&D technologies that

have marketplace utility.



Licensing Opportunities

Power Tool and Brushless DC Motor/Motor Controller

Description: The Hubble Space Telescope (HST) Power Tool and Brushless DC Motor/Motor Controller is the latest in the history of successful development of advanced power tools for on-orbit payload servicing. It is a self-contained, power-driven 3/8 inch drive nut driver used by astronauts during extravehicular activities (i.e., "space walks"). There are a number of capabilities of the Power Tool and Brushless DC Motor/Motor Controller including:

- Precision power tool fastening system
- Low-volume, high voltage rechargeable batteries

- Miniature brushless DC-motor control electronics
- Computer programmable torque, speed, and angle control
- Data collection for torque, angle, and turns
- Warning display system for battery, temperature, low/high torque, and software faults

Delivering and recording accurate torque/angle profiles is a requirement in a wide variety of manufacturing assembly disciplines. Current systems for torque/angle delivery and recording are large and require external power sources. The Power Tool and Brushless DC Motor/Motor Controller provides industry with the capability to incorporate precision, flexibility, miniaturization, and portability into their activities.

Licensing Opportunities at-a-glance:

Technology: The Power Tool and Brushless DC

Motor/Motor Controller is a self-contained, portable, power-driven, 3/8 inch drive nut driver with programming, recording, and display capabilities.

Utilities: The Power Tool and Brushless DC Motor/Motor Controller can be used for applications of manufacturing processes that require portability, programmability, and/or data collection and display.

Patent No.: 13706

Low Cost Bolt Analyzer

Description: As implemented at GSFC, the Bolt Analyzer consists of a notebook computer, analog-to-digital converter, base plate, torque wrench, and load washer. The load washer is a commercially available sensor with known elasticity coefficients and bonded strain gauges. When compressed and connected to the Bolt Analyzer, it gives an accurate indication of clamping force. Similarly, a transducer on the torque wrench is used to monitor torque. Marking paper for receiving torque-angle indicia is optional. This method allows the turn-of-the-nut method to be used to determine the fractional number of turns necessary to develop the required preload.

To initialize the system, fastener properties such as yield strength and nominal diameter are entered first. Next, target information such as percentage of yield is needed. Based on these values, the Bolt



Analyzer assumes a coefficient of friction of 0.15 to calculate a predicted torque and compressive load. These values aid in selecting the correct load washer and torque transducer. The Bolt Analyzer recognizes what type of load washer and torque transducer have been connected and automatically factors



in the correct calibration constants. As torque is applied to the fastener, the computer displays actual tensile stress, percentage of yield, measured torque, friction coefficient, and clamping force in real time. Overload conditions in any transducer trigger an alarm. Several options are available for displaying and storing the data.

Licensing Opportunities at-a-glance:

Technology: Low Cost Bolt Analyzer

- Utilities:
- Analyze bolted joint coefficient of friction and stress
 - Test and screen threaded fasteners nondestructively
 - Train engineers and technicians in bolted joint mechanics
 - Verify fastener lubricants or thread locking agents.

Patent No.: 5287747

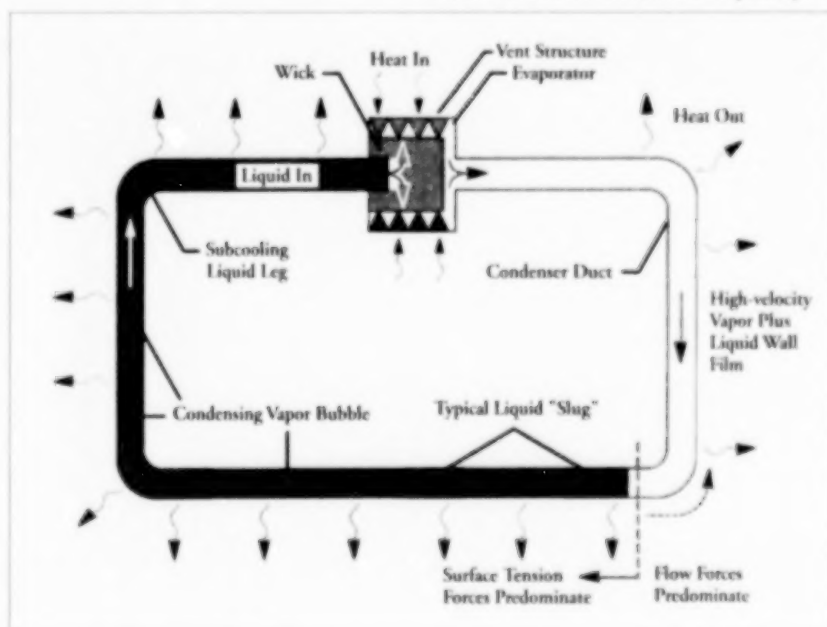
Capillary-Pumped Loop

Description: Based on 14 years of technology development at GSFC, the capillary-pumped loop is a two-phase heat transport device. Its simplistic system utilizes the surface tension forces developed in a fine-pore wick to circulate a working fluid through pipes or tubing and requires no moving parts or external pumping. The device is capable of transferring large heat loads over long distances with small temperature differentials.

The basic process for capillary-pumped loops involves absorption of heat through the evaporation by the vapor and returns the working fluid to a liquid. Tubing returns the liquid to the evaporator to complete the cycle. The cycle will continue as long as the evaporator is in contact with a heat source and the condenser is able to reject the heat to a cool area.

This two-phase thermal transport system offers significant performance advantages over conventional single-phase systems for various reasons. These include orders-of-magnitude less pumping power required with orders-of-magnitude greater heat transfer potentials resulting in smaller temperature gradients and smaller radiators (the condenser for the capillary-pumped loop). The major limiting factor in applying this technology is the need to maintain a height differential between the evaporator and the condenser that will not negate the absorption power of the wick.

This technology has undergone extensive ground testing and two space flight experiments which have proved that the capillary-pumped loop is a reliable and versatile thermal transport system for space applications. With some modification, this technology has potential for many Earth-bound applications also. For instance, a bio-capillary-



pumped loop can be used to warm parts of the human body such as hands, feet, ears, etc. when insulation alone is insufficient, by transferring excess heat from warmer areas (e.g., behind the knee or elbow, armpit, groin, trunk, etc.). Conversely, a bio-capillary-pumped system can cool parts of the human body when helmets, clothing, and other protective gear cause excess heat buildup.

These bio-systems, however, are limited by the working fluid.

Current fluids are not safe to humans, and research is being performed to identify a safe working fluid for these bio-systems.

Bio-capillary-pumped loops can be made as discreet components from inexpensive materials. Other uses, not limited by the choice of working fluids, may include cooling systems for electronics or those applications requiring that the cooling system need no external power. The medical field may also benefit from this type of cooling/heating system.

Licensing Opportunities at-a-glance:

Technology: Capillary-Pumped Loops for thermal control.

Utilities: Aerospace, Electronics, Medical Instrumentation, Construction Industries, and Outerwear and Outdoor Gear Manufacturers.

Patent No.: Pending

Residual Stress Detection Using Eddy Currents

Description: Quality is the most important engineering factor that dictates the safety, reliability, performance, and competitiveness of a product. To ensure a superior product, various quality assurance measurements such as mechanical testing, nondestructive evaluation, and life-cycle testing must be made to fully characterize properties of material and structures.

GSFC has developed and patented an innovative laser-induced eddy current imaging system (device, software, and method) for advanced material characterization through nondestructive evaluation. The basic operating principle of this system is the monitoring of the relative changes in material electromagnetic properties induced by laser effects. Modulated laser pulses impinge on the surface of a specimen and generate thermal strain and elastic strain that propagate in the material. An eddy current sensing probe is used to monitor the changes in the material electromagnetic parameters induced by the thermal and elastic strains. By modulating the laser excitation pulse and scanning the beam with an optical scanning device, an eddy current image can

be produced based on the sample coordinates of the laser impingement.

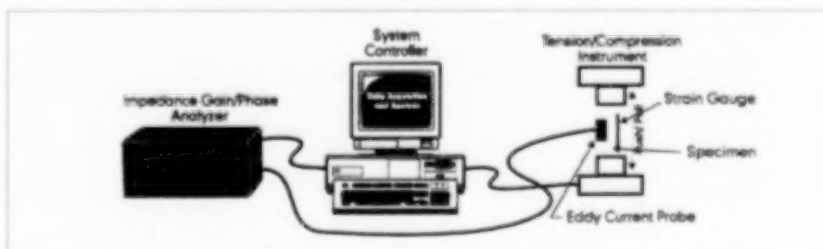
This system consists of four major hardware components: a modulated laser source (excitation source), an X-Y scanning mirror assembly (to steer the laser beam to the point of interest on the specimen surface), an eddy current measuring system, and a data acquisition system controller. The laser induced eddy current imaging system is one of the advanced evaluation systems that can be implemented for qualification, process monitoring, quality assurance, failure analysis, etc. Potential applications of this system are in material homogeneity, joint integrity, defect detection, damage assessment, and probe characterization. This system might also be used for mapping to characterize eddy current probes.

Licensing Opportunities at-a-glance:

Technology: Nondestructive evaluation of residual stress using laser-induced eddy current imaging.

Utilities: Aerospace, electronics, quality assurance instrumentation, nondestructive evaluation instrumentation.

Patent No.: 5193395



Capaciflector-Based Technology

Description: The Capaciflector is a capacitive sensing element backed by an active reflector element that acts as a shield to reflect field lines. The capacitive coupling between the sensors and the object is used to control the signal amplitude and the signal phase. As an object moves closer, the capacitance increases and the amplitude and phase change, allowing varying detection ranges for objects. The active shield reflector is electrically isolated from the sensor and follows the input signal, keeping it at the same amplitude and phase with the electric field of the sensor. The reflector therefore reflects the electric field of the sensor without being affected by the coupling between the sensor and the approaching object.

The Capaciflector can be used as a single unit or as a closely packed array. Even though the sensors are separated only by a few thousandths of an inch in the array, there is virtually zero cross-talk. In the array configuration, each sensor performs independently as a Capaciflector, operating off a common driven shield and locked to a single oscillator in frequency, amplitude, and phase. Flexible printed circuit boards have been constructed of Capaciflector arrays that can image in 3-D and act as a "capaciflector camera". The Capaciflector array concept has also been extended to

embedding the sensors into structures so that they become loading parts of the structure. Applications for this aspect include self-diagnostic systems and end-effectors for robots.

Benefits:

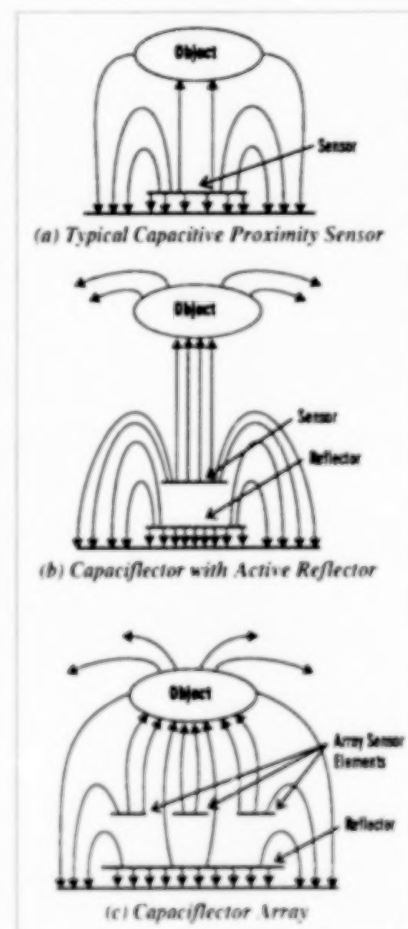
- **Versatile:** any number of configurations and combinations are possible – large or small, 2-D or 3-D, single sensors or as an array, all types of shapes, coated or embedded, etc.
- **Compact:** smaller than other sensory devices, it reduces sensor-mounting standoff to virtually zero.
- **Rugged:** in December 1992, the Capaciflector performed flawlessly as a proximity sensor on the feet of the Dante robot, which walked into the extreme environment of an Antarctic volcano.
- **Stable:** there are no thermal drift problems; the Capaciflector provides a virtually crosstalk-free performance.
- **Precise:** dramatically increased detection range and sensitivity over competing technologies. During the Space Shuttle STS-64 mission in September 1994, as part of the Robot Operating Materials Processing System, the Capaciflector enabled a NASA record precision alignment of less than 0.004 inches.
- **Efficient:** requires milliwatt energy, which makes it practical for industrial, embedded, and remote applications.

Licensing Opportunities at-a-glance

Technology: Capaciflector-Based Technology

Utilities: Industrial Robotics, Self-Sensing Systems, and Clandestine Security

Patent No.: Pending

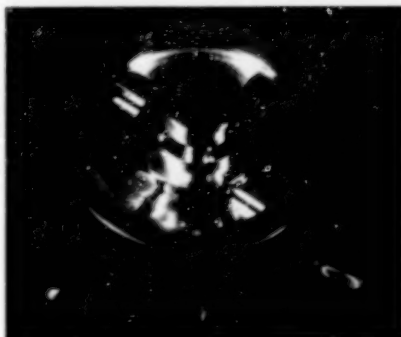


Three-Dimensional Roller Locking Sprag

Description: The 3-D Sprag technology was developed at NASA/GSFC and relates to mechanical brake, clutch, and similar mechanisms. More specifically, this technology relates to roller type locking devices which couple torque between a drive member and its driven or fixture member.

The 3-D Sprag technology is a significant improvement in roller-type locking brakes and clutches. the 3-D Sprag is an advancement over conventional sprags because it:

- Provides a shorter axial length without sacrificing performance.
- Enhances the effectiveness and



reliability of the lock-up between the drive member and the reaction member.

- Eliminates the axial migration of the sprag by keeping at least one sprag member confined to a groove.
- Reduces stress by reducing thick and long sprag sinibers and through the elimination of large contact areas and small cam angles.

Licensing Opportunities at-a-glance

Technology: Three-Dimensional Roller Locking Sprag

Utilities: Coupling, Brake, Clutch, and Power Train systems.

Patent No.: Pending

Technology Transfer Opportunities—1995 New Technologies Reported

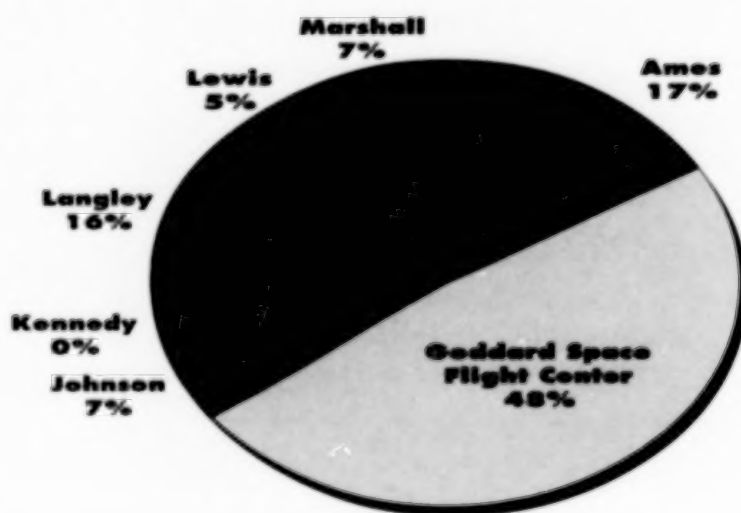
- 1 Multiple Field of View Star Tracker
- 2 Linear Electromagnetic Actuator
- 3 The Game Entitled "HNSXZ"
- 4 A Dual-Amplitude and Dual Time-of-Flight Ultrasonic Imaging System
- 5 3-D Capaciflector
- 6 Adjustable Feed Support for Satellite Antennas
- 7 Method and Means of Ultra-High Sensitive, Absolute, Linear Encoding
- 8 Control Of Thermotropic LCPs Through Orientation in a Magnetic Field
- 9 Three-Axis Satellite Attitude Control by Torquing a Magnetic Bearing Inertia Wheel
- 10 Pistol Grip Power Tool
- 11 Dual Antenna-Compensating Combiner (DACC)
- 12 Segmented Cold Cathode Display Panel
- 13 Interior Circuit Board Supports and Method
- 14 Continuously Variable Planetary Transmission (CVPT)
- 15 Deployment Hinge
- 16 Method and Apparatus for Minimizing Unwanted Dynamics in a Physical System
- 17 Spacecraft Environment Modeling Tools for Use with MatLab Software
- 18 Field Programmable Gate Array (FPGA) Anti-Fuse Single Event Failure
- 19 Improved Chemical/Mechanical System and Methods Using Two Phase/Two Component Compression Heat Pump
- 20 Conceptual Design of the Hubble Space Telescope Model, Single Spline-Radial Support X Structure
- 21 An Efficient Fast Response Bi-directional Current Controller for Magnetic Bearings or DC Motors
- 22 Rapid Setup Shop Tooling
- 23 A Compact Ultrasonic Multi-Degree-of-Freedom Positioning System Orbital Debris Mitigator
- 24 Using Silicon Coating for Braze-Joining Applications-Improved Horizon Sensor Scheme
- 25 Electric Discharge Machine Polishing of Titanium Alloy
- 26 Submillimeter-Wave Anechoic Absorber
- 27 Automated B-H Curves for Magnetic Hysteresis Rods Used for Spacecraft Attitude Control
- 28 Universal FPGA Burn-in Boards
- 29 A PC-based Acquisition and Compact Disc Recording System
- 30 A Low-Cost, Balloon Launched, Remotely Piloted Vehicle for Meteorological Research
- 31 Improved Horizon Sensor Scheme
- 32 Medication Dispenser Assistant
- 33 Single Crystal Growth of GaN via Diffusion Bonding
- 34 Improved Horizon Sensor Scheme
- 35 No Mess Paint Lid
- 36 Radial Flow Heat Exchanger, PD-171
- 37 Application to User Interface Communication Model
- 38 Low-Cost, High-Performance Cryogenic Heat Exchanger
- 39 Rotary Dampers for Deployable Space Structures
- 40 Pointing/Roll Mechanism for the Ultraviolet Coronagraph-Spectrometer
- 41 Development of a Heat-Driven Pulse Pump (HDPP)
- 42 Linear Motion Device
- 43 Radiative Cooler Patent
- 44 Frequency Agile Fiber Optic Modem Tunes Two Decades
- 45 Deflection in a Circular Membrane Due to Transverse Loads
- 46 Microwave Spacecraft Battery Charger
- 47 Improved Contacts for Wire-Bonding to Yttrium-Barium-Copper-Oxide (YBCO) Superconducting Thin Films
- 48 Frequency Sensitive Solometer Resonance Meshes

What the Office of Patent Counsel Does to Facilitate Technology Transfer

The Office of Patent Counsel is involved in many aspects of the Technology Transfer/Commercialization Program at NASA/GSFC. While providing the more traditional functions of patent preparation and prosecution, the Office is also intimately involved in preparing agreements in response to public inquiries regarding GSFC technologies, promoting GSFC technologies through participation in conferences and tradeshow, and acting as counsel to the Office of Commercial Programs (OCP). The Office of Patent Counsel provides counsel to the OCP in all aspects of intellectual property.

All of these functions represent vital components in the GSFC Technology Transfer/Commercialization Program. In support of NASA's striving to reinvent itself through the Agenda for Change, the Office of Patent Counsel aggressively performs each of these functions in the spirit of *Better, Faster, Cheaper*. These efforts are beginning to show rewards as the royalty income received for GSFC technologies was nearly 50% of the royalty income received for NASA technologies during the 1995 fiscal year.

NASA Technology Royalties for 1995 by Center



CONFERENCES, MEETINGS, AND SYMPOSIA

- March 27 **SBIR Conference** Anaheim, California
- April 4-7 **US Space Foundation 11th National .. Space Symposium** Colorado Springs, Colorado
- April 6-7 **Technology Opportunity Showcase** ... Hampton, Virginia
- May 25 **25th Annual Goddard Space Flight ... Center Small and Small Disadvantaged Business Conference** Greenbelt, Maryland
- June 27-28 **Opportunity for Technology Transfer . and Partnering** Santa Fe, New Mexico
- August 8-10 **New England/NASA Business and Technology Meeting** Providence, Rhode Island
- September 10-15 **Air Traffic Control Conference** Las Vegas, Nevada
- September 12 **Retired Federal Employees Meeting** .. Fairfax, Virginia
- September 12-15 **The 8th International Technical Meeting of the Satellite Division of the Institute of Navigation** Palm Springs, California
- September 27-29 **GSFC Sensors Commercialization Workshop** Utica, New York
- October 22-27 **Technology 2005** Chicago, Illinois

Through sponsorship, chairmanship, and participation in conferences, meetings, and symposia, GSFC is able to disseminate information about space technologies and their potential commercial applications to both the private and public sectors. Throughout each quarter of 1995, GSFC successfully reached small and large companies; federal, state, and local government agencies; academic institutions; and trade and professional organizations. Below are a few highlights of these events:

Goddard Space Flight Center's Annual Small and Small Disadvantaged Business Conferences

Held on May 25, 1995, the Annual Small and Small Disadvantaged Business Conference was conducted on-site at GSFC. The OCP Technology Transfer/Commercialization Office participated by offering one-on-one counseling to industry about business opportunities at GSFC. Literature on these programs was distributed, and ways to partner with the Technology Transfer/Commercialization Office and the Small Business Innovation Research (SBIR) Programs Office were discussed.

Air Traffic Control Conference

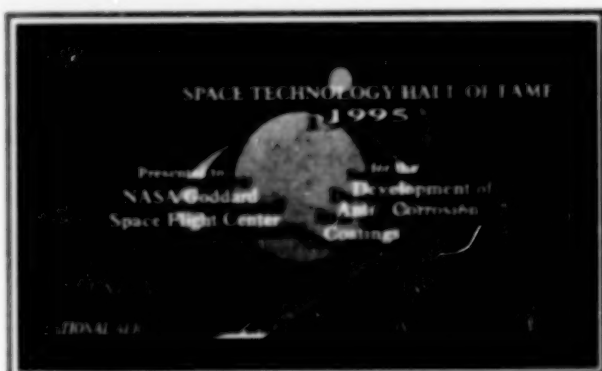
On September 10-15, 1995, GSFC attended the Air Traffic Control Conference in Las Vegas, Nevada. GSFC exhibited Weather in the Cockpit technology. As a result of participating in this conference, GSFC developed new leads on transferring the technology and additional commercial applicability of it.

Goddard Space Flight Center's Sensors Commercialization Workshop

The Third Annual Northeast Regional Technology Transfer and Commercialization Workshop sponsored by GSFC was held September 27, 1995 in Utica, New York. Four GSFC scientists and engineers presented current projects in the sensors area, including projects on Capaciflector-based Technologies, Infrared Sensors, and CdZnTe Strip Gamma Ray Detectors for Medical Imaging. The GSFC staff also served as moderators for a panel of presenters representing industry and other government laboratories.

For its contributions to America's scientific and technological growth, GSFC is a leader in America's space exploration community. Since the inception of the U.S. Space Technology Hall of Fame awards in 1988, GSFC has been consistently recognized for its extraordinary innovations. These innovations continue to benefit America through their far-reaching commercial applications.

U.S. Space Technology Hall of Fame Awards



1995 IC531 Corrosion Resistant Coating

1994 Digital Image Processing Medical Applications

1992 Direct Readout Satellite Data

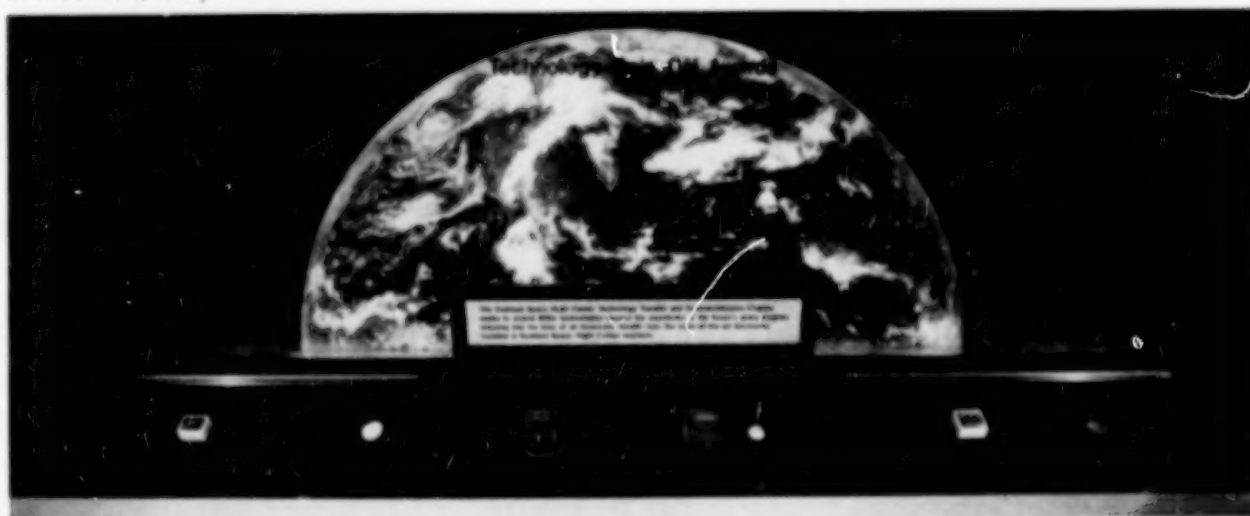
1991 Automatic Implantable Cardioverter Defibrillator

1989 Cordless Tools

1988 NASTRAN Software

Programmable Implantable Medication System

An exhibit of the recipient technologies for the Technology Spin-Off Awards is currently on display in the lobby of Building 8 at GSFC in Greenbelt, Maryland



OSFC would like
to extend its
appreciation to
civil servants who
have participated
in reporting
new technologies
during 1993-1995

Bristow, John	Flatley, Thomas	Krainak, Michael	Parker, James	Sharma, Rajeev
Chern, Engrain	Galosky, David	Krebs, Daniel	Paulkevich, John	Sigman, Clayton
Clagett, Charles	Hermida, Alfonso	Ku, Jentung	Payne, Leslie	Simonds, Stephen
Coleman, Alexander	Heymsfield, Gerald	Leviton, Douglas	Poland, James	Smith, Brian
Cudmore, Alan	Houser, Jeffrey	Lui, Ben	Premack, Timothy	Szczur, Martha

Baker, Joanne	Cummings, Robert	Hughes, Peter	Madison, Laurence	Puckett, David	Tooley, Craig
Benner, Steve	Dabney, Philip	Jelectie, James	Miller, Jay	Richards, Paul	Unger, Glenn
Bergman, David	Desch, Michael	Johnson, Patricia	Moxley, Ronald	Richon, Karen	Vranish, John
Blake, Peter	Dew, Howard	Katz, Richard	Muller, Ronald	Savadkin, Bruce	Watson, John
Blau, Michael	Famiglietti, Joe	Keith, Benjamin III	Novello, Joseph	Schwemmer, Geary	Whitley, Raymond
Brasunas, John	Farrell, William	Kolaninski, John	Ong, John	Scruggs, Steven	Yang, Chao

Call for tech transfer opportunities!

END

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